Claims

1. Process for preparing a homogenous mixture of coated particles containing a graphite based conductive nucleus and at least one partial or complete coating of the surface of said nucleus, the coating being based on an interactive functional agent consisting of a material that differs in composition and/or in physical shape from the material that constitute the nucleus of the coated particles, said process including at least one step of crushing particles of the graphite nucleus together with particles of the interactive functional agent, the particles of graphite having an average size Y and those of the interactive functional agent having an average size X such that the ratio Y/X is smaller than 1.

2. Process according to claim 1, in which the interactive functional agent is selected from the group consisting of:

   - graphite having a shape that differs from that of the graphite(s) that constitute(s) the nucleus but belonging to the same class of crystallinity;
   - ceramics (preferably ceramics of the type TiO_2, Al_2O_3, ZrO_2, SiC, Si_3N_4, still more preferably those of the type TiO_2, and/or ZrO_2);
   - fluoride salts such as LiF or alkaline-earth fluorides such as (LiF) CaF_2;
   - metals and alloys (preferably alloys of the metallic type, still more preferably the metallic alloys containing one of the elements of the group consisting of Si, Sn, Ag, and Al);
   - oxides, preferably oxides of the type MgO, Li_2CO_3 and SiO_2;

- polymers that are solid at room temperature such as:
  - o four branch polymers preferably having hybrid terminals, still more preferably those having hybrid acrylate terminals (preferably methacrylate) and alkoxy (preferably alkoxy with 1 to 8 carbon atoms, still more preferably methoxy or ethoxy), or vinyl; one branch at least (and preferably at least two branches) of said four branch polymer being capable of giving rise to cross-linking,
  - o polyoxypropylenes and polyoxyethylenes with an average molecular weight that advantageously varies from 150 to 20,000,
  - o polysiloxanes ([Si(R)-O]-) such as those of the type poly(dimethyl)siloxane, poly(ethoxysiloxane), poly(octamethyl)trisiloxane, preferably having a molecular weight that varies from 150 to 10,000, still more preferably polyoxysiloxanes of the type Poly(dimethylsiloxane-co-methylphenylsiloxane) preferably having a molecular weight of about 800; and
  - o mixtures of at least two of the above.

3. Process according to claim 1 or 2, in which the size of the particles that are subject to crushing is selected so that X is at least 150%, and preferably at least 200% higher than Y.

4. Process according to any one of claims 1 to 3, in which at least 10%, preferably at least 80%, of the surface of the nuclei is covered with a coating.

5. Process according to any one of claims 1 to 4, in which the homogenous mixture of coated particles obtained is characterized by a size distribution having a single peak, preferably when the particle size is measured with the Microtrac X100 apparatus of MICROTRAC and/or by means of a conversion rate ≥ 90 %.

6. Process according to any one of claims 1 to 5, in which the crushing step is carried out under inert atmosphere, preferably consisting of a gas selected from the group consisting of argon and nitrogen and mixtures thereof, still more preferably in the presence of argon.

7. Process according to any one of claims 1 to 6, in which the crushing step is carried out at a temperature between 20 and 1000° C, preferably at a temperature between 25 and 800° Celsius.

8. Process according to any one of claims 1 to 7, in which the crushing step is carried out for a period comprising between 10 seconds to 4 hours, preferably for a period comprises between 60 seconds to 3 hours.

9. Process according to any one of claims 1 to 8, in which the crushing step is carried out in the presence of a solvent preferably selected from the group consisting of water, organic solvents, inorganic solvents, and mixtures of at least two thereof, preferably the solvent is selected from the group consisting of water, ketones, alkenes, alkanes and alcohols, still more preferably the solvent is selected from the group consisting of water, acetone, toluene, heptane, methanol and mixtures thereof with water.

10. Process according to any one of claims 1 to 9, in which the solvent used is water.

11. Process according to claim 9 or 10, in which the quantity of solvent used represents from 1 to 10 % and preferably from 2 to 5 % by weight of the total weight of the coating-particles that are present in the mixture of particles subject to crushing.

12. Process according to any one of claims 1 to 11, in which the particles of size X and/or those of size Y are cylindrical, prismatic and/or in the form of blades.

13. Process according to any one of claims 1 to 12, in which the X/Y ratio varies between 0.17 and 0.6, preferably said ratio varies between 0.25 and 0.35.

14. Process according to any one of claims 1 to 13, in which the crushing is carried out mechanically, preferably by HEBM, by jet air-milling, by mechano-melting of the Hosokawa type, by hybridization (preferably by using a NHS-O system marketed by NAR- Japan) and/or by using a combination of these techniques.

15. Process according to claim 14, carried out by mechano-melting at a rotation speed of the installation between 2000 and 3000 rotations/minute, preferably said rotation speed is between 2300 and 2700 rotations/minute.

16.Process according to claim 15, implemented for a period between 10 and 210 minutes, still more preferably for a period between 15 and 60 minutes.

17.Process according to any one of claims 1 to 16, in which the particles of the mixture obtained are ellipsoidal.

18.Process according to any one of claims 1 to 17, in which the tap density of the mixture of particles obtained is at least twice higher that that of the particles of size X that are used when starting said process.

19.Process according to claim 18, in which the tap density of the final product is > 0.9 g/cc, preferably the tap density is ≥ 1 g/cc.

20.Process according to any one of claims 1 to 19, in which the specific surface area (BET) of the particles of size X varies between 1 and 50 m^2/g, preferably the specific surface area is between 2 and 10 m^2/g.

21.Process according to any one of claims 1 to 20, in which the specific surface area (BET) of graphite Y varies between 5 and 800 m^2/g, preferably said specific surface area varies between 10 and 500 m^2/g.

22. Process according to any one of claims 1 to 21, in which the particles of average size Y are ceramic particles hereinafter designated particles of size Yc.

23. Process according to claim 22, in which the Yc/X is lower than 1, preferably said ratio is between 0.0008 and 0.007.

24. Process according to claim 22 or 23, in which the ceramic is electronically conductive, and is preferably selected from the group consisting of nitrides, such as TiN and GaN.

25. Process according to claim 21 or 22, in which the ceramic is electronically non-conductive and is preferably selected from the group consisting of Al_2O_3 and $BaTiO_3$.

26. Process according to claim 21 or 22, in which the ceramic is electronically semi-conductive and is preferably selected from the group consisting of SiC and $BaTiO_3$.

27. Process according to claim 21 or 22, in which the particles of ceramic have an average size Yc such that 10nm < Yc < 1 µm, preferably such that 50nm < Yc < 150nm.

28. Process according to any one of claims 1 to 20, in which the particles of average size Y are particles of an alloy (hereinafter designated particles of size Ya) consisting at least in part of Al, Sn, Ag, Si or a mixture of at least two thereof.

29. Process according to claim 28, in which ratio Ya/X is such that 0.005 > Ya/X > 0.2, preferably said ratio verifies the relationship 0.007 > Ya/X > 0.0008.

30. Process for preparing a homogenous mixture of coated particles according to any one of claims 1 to 29, said coated particles including a graphite based conductive nucleus and at least two partial or complete coatings of said nucleus, the coating particles obtained in the first crushing step being subject to a second crushing in the presence of an interactive functional agent that is identical or different from the first interactive functional agent used in the first crushing step, the average size of the particles of the second interactive functional agent being smaller than the size of the coated particles obtained in the first crushing step.

31. Process according to claim 30, in which the coated particles that are prepared include a graphite based conductive nucleus and at least three partial or complete coatings of said nucleus, the coated particles obtained in the second step of crushing being subject to a third crushing in the presence of an interactive functional agent that is identical to or different from the interactive functional agents used in the first two crushing steps, the average size of the particles of the third interactive functional agent being smaller than that of the coated particles obtained in the second crushing step.

32. Coated particle capable of being obtained by one of the processes according to any one of claims 1 to 31.

33. Particle containing a nucleus that at least partially consists of graphite, said particle being continuously or discontinuously coated with at least one layer of a material obtained from an interactive functional agent selected from the group consisting of graphite,

ceramics, metals and alloys (such as alloys of metallic type) as well as mixtures of at least two thereof.

34. Particle according to claim 32 or 33, consisting of a graphite nucleus with a purity higher than 95 %.

35. Particle according to claim 34, in which the impurities that are present in the nucleus do not interfere with the electronic properties of said particle.

36. Particle according to claim 35, in which the coating of the nucleus neutralizes electronic interferences generated by the impurities that are present in the graphite nucleus.

37. Particle according to any one of claims 32 to 36, in which the size of the nucleus is between 7 and 100 micrometers, preferably the size of the nucleus is between 10 and 30 micrometers.

38. Particle according to any one of claims 32 to 37, in which the coating of the nucleus is made of graphite and has an average thickness between 1 and 5 micrometers.

39. Process according to any one of claims 32 to 38, in which the coating of the nucleus is made of a ceramic and has an average thickness between 50 and 150 nanometers.

40. Particle according to any one of claims 32 to 33, in which the nucleus is covered with two consecutive continuous and/or discontinuous layers, each of the layers preferably having

respective thicknesses E_1 and E_2 comprised between 50 nanometers and 5 micrometers.

41. Particle according to claim 40, in which each of the 2 layers consists of a different material.

42. Particle according to any one of claims 32 to 41, in which the nucleus is covered with three layers, each of the 3 layers respectively having a thickness E_1, E_2, E_3 preferably comprised between 50 nanometers and 5 micrometers and the thicknesses of the three layers being such that their sum is preferably lower than 10 micrometers.

43. Particle according to claim 42, in which each of the 3 layers consists of a different material.

44. Particle according to claim 32 or 33, consisting of a graphite core wherein at least 80 % of its external surface is covered with said coating.

45. Mixture of particles as obtained by implementation of one of the processes defined in any one of claims 1 to 31 or as defined in one of claims 30 to 40 and having at least one of the following properties:

- an electronic conductivity between 10^{-22} and 10^{3} $Ohm^{-1}.cm^{-1}$; and
- a particle size distribution preferably restricted between [-50 %,+50 %].

46. Mixture of particles according to claim 45, in which the nucleus consists of graphite, the coating is of metallic type and the electronic conductivity is higher than 300 $Ohm^{-1}.cm^{-1}$.

47. Mixture o f particles a ccording t o claim 46, in which the c oating consists of aluminum and the electronic conductivity is higher than $Ohm^{-1}.cm^{-1}$, preferably higher than about 377 x 103 $Ohm^{-1}.cm^{-1}$.

48. Use of the particles according to claim 47 as insulating material or conductor for an electrode of an electrical generator.

49. Use of particles according to claim 45, coated with CeO_2, Li_3PO_4, graphite-Ag and/or MgO-graphite in fuel cells.

50. Use of particles according to claim 48, coated with polymers-graphite, in coatings, preferably paints.